

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)


Applicant's or agent's file reference PWO021201		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/GB 03/03271	International filing date (day/month/year) 29.07.2003	Priority date (day/month/year) 30.07.2002	
International Patent Classification (IPC) or both national classification and IPC B24B1/00			
Applicant RAYSUN INNOVATIVE DESIGN LIMITED et al.			

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.
  - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  27.02.2004	Date of completion of this report  12.11.2004
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Koller, S  Telephone No. +49 89 2399-2841



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/GB 03/03271**

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, Pages**

1-13 as originally filed

**Claims, Numbers**

1-33 received on 12.08.2004 with letter of 12.08.2004

**Drawings, Sheets**

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-25,29-33
	No: Claims	26-28
Inventive step (IS)	Yes: Claims	1-25
	No: Claims	26-33
Industrial applicability (IA)	Yes: Claims	1-33
	No: Claims	

2. Citations and explanations

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

- D1:** US 2002/068518 A1 (PRESTON JAY B ET AL) 6 June 2002  
**D2:** US-A-5 993 297 (HYATT GREGORY AARON ET AL) 30 November 1999

1. Diamond bonded abrasive wheel (claims 26-33)

**Claims 26-28:** The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claims 26-28 is not new in the sense of Article 33(2) PCT, since documents **D1** and **D2**, both disclose all features of these claims.

**Claims 29-33:** The subject-matter of claims 29-33 does not involve an inventive step in the sense of Article 33(3) PCT.

No inventive step can be seen in applying different bonding agents for the diamond particles, also since these agents as bonding material are well known by the skilled person.

Also no inventive step can be seen by varying the number of abrasive wheels and their grinding profile.

2. Apparatus for high speed grinding (claims 1-18)

**Claim 1:** The document **D1** is regarded as being the closest prior art to the claim, and shows all features its subject-matter, except the feature "a nozzle spaced from the wheel arranged to direct a jet of liquid coolant to the periphery of the wheel to clean the surface of the wheel".

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as maintaining a clean grinding surface in addition to the cooling of the same.

The solution to this problem, i.e. an additional provision of coolant supply through a nozzle to the grinding surface, as proposed in claim 1 of the present application is

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considered as involving an inventive step (Article 33(3) PCT).

**Claims 2-18:** The claims 2-18 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty (Article 33(2) PCT) and inventive step (Article 33(3) PCT).

3. The subject-matter of the remaining **claims 19-25** seem also to fulfill the criteria of Article 33(1) PCT with respect to novelty (Article 33(2) PCT) and inventive step (Article 33(3) PCT).

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## CLAIMS

1. Apparatus for high speed grinding comprising a diamond bonded abrasive wheel, drive means for mounting and rotating the abrasive wheel at peripheral speeds up to approximately 200 m/s, and a liquid coolant supply system including delivery means arranged to direct liquid coolant to a point or zone of grinding contact and a nozzle spaced from the wheel arranged to direct a jet of liquid coolant to the periphery of the wheel to clean the surface of the wheel, wherein the grinding wheel comprises an internal chamber from which liquid coolant can be directed to a grinding surface of said wheel, a number of liquid coolant supplies being directed into the said chamber.
2. Apparatus as claimed in claim 1, wherein coolant delivery from said supplies into said internal chamber are arranged to be controlled by zone of said chamber.
3. Apparatus as claimed in claim 2, wherein the chamber has four zones for coolant delivery.
4. Apparatus as claimed in claim 2 or 3, wherein the zones of the internal chamber are arranged to be provided with liquid coolant in any combination so that the point or zone of grinding contact, in use, is flooded with coolant.
5. Apparatus as claimed in any one of claims 2 to 4, wherein the zone or zones of the internal chamber can be switched on through a machine control in a manner to ensure the contact point or zone is flooded with liquid coolant.
6. Apparatus as claimed in anyone of claims 2 to 5, in which a controller is provided to control the rotational speed of the wheel and to select a contact zone to which liquid coolant is supplied.
7. Apparatus as claimed in any preceding claim, wherein coolant delivery means is provided through the abrasive wheel, which delivery means comprises a plurality of channels connecting the internal chamber of the abrasive wheel to its exterior surface.

8. Apparatus as claimed in claim 7 wherein the plurality of channels is provided by radial slots formed in the abrasive wheel.
- 5 9. Apparatus as claimed in any preceding claim, wherein liquid coolant supplied to said internal chamber is directed within the chamber by guide means towards the point or zone of grinding contact.
- 10 10. Apparatus as claimed in any preceding claim wherein a liquid coolant supply system in use, delivers liquid coolant to the chamber at a pressure up to 100 Bar.
11. Apparatus as claimed in any preceding wherein the jet of liquid coolant is supplied to the nozzle at a pressure in excess of 40 Bar.
- 15 12. Apparatus as claimed in any preceding claim wherein coolant delivery routes are provided internally of and externally to the wheel from a single coolant delivery system or mechanism.
- 20 13. Apparatus as claimed in any preceding claim wherein the jet of liquid coolant to clean the wheel is directed at the periphery of the wheel to a point spaced from the contact zone.
- 25 14. Apparatus as claimed in any preceding claim wherein second nozzle means is provided and arranged to direct a jet of liquid coolant away from the point or zone of grinding contact in a direction substantially radial to the periphery of the wheel.
15. Apparatus as claimed in any preceding claim wherein there further comprises a controller to control the rotational speed of the grinding wheel and select a contact zone to receive liquid coolant.
- 30 16. Apparatus as claimed in any preceding claim wherein the abrasive wheel is diamond bonded in either a resin, galvanic, vitrified or metal bonded construction.
17. Apparatus as claimed in any preceding claim wherein the coolant delivery means is moveable to facilitate an abrasive wheel or workpiece change operation.

18. Apparatus as claimed in claim 17, incorporating automated nozzle setting including a two-axis motion to permit movement of the coolant supplies out of the internal chamber and then rotation through 90°.

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19. Apparatus for high speed grinding comprising a multi-axis machining centre including an automated tool changer and apparatus as claimed in any preceding claim.

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20. Apparatus as claimed in claim 19, in which the machining centre comprises a machine tool magazine loaded with a plurality of different profiled abrasive wheels as defined in claim 1.

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21. A method of carrying out a grinding operation on a workpiece at a high material removal rate using apparatus as claimed in any preceding claim, which method includes the steps of (i) setting up the abrasive wheel for a series of cuts of potentially different depths either "up cut" or "down cut" grinding; (ii) selecting the required zone of the internal chamber; (iii) setting up the apparatus to direct liquid coolant at the grinding contact point or zone; and (iv) grinding a workpiece by rotating the abrasive wheel in contact therewith at peripheral speeds in excess of 10 m/s.

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22. A method as claimed in claim 21 in which the apparatus comprises a workpiece table, the method further comprising the step of moving the table at a speed in excess of about 2 m per minute.

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23. A controller constructed and adapted to control high speed grinding apparatus as claimed in any one of claims 1 to 20, which controller comprises a central processor, a manual input means and separate means controlled by said central processor for controlling individually (i) the liquid coolant supply to the delivery means supplying liquid coolant to the point or zone of grinding contact and (ii) a liquid coolant supply arranged to clean the grinding wheel.

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24. A controller as claimed in claim 23 wherein the means for controlling the liquid coolant supply is a matrix of valves within the liquid coolant delivery system.



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25. A control system for controlling the operation of an apparatus as claimed in any one of claims 1 to 20 comprising the steps of (a) activating the liquid coolant supply; (b) selecting rotational speed of abrasive wheel; (c) selecting the nozzle zone of the internal chamber (d) activating a grinding cycle; and (e) terminating the liquid coolant supply.
26. A diamond bonded abrasive wheel suitable for use in an apparatus as claimed in any one of claims 1 to 20, comprising an internal chamber into which a number of liquid coolant supplies can be directed, and coolant delivery means being provided through the abrasive wheel.
27. An abrasive wheel as claimed in claim 26, wherein the delivery means comprises a plurality of channels connecting its internal chamber to its exterior surface.
28. An abrasive wheel as claimed in claim 27, wherein the plurality of channels is provided by radial slots formed therein.
29. An abrasive wheel as claimed in any one of claims 26 to 28, in which the diamond is resin bonded.
30. An abrasive wheel as claimed in any one of claims 26 to 28, in which the diamond is galvanic bonded.
31. An abrasive wheel as claimed in any one of claims 26 to 28, in which the diamond is vitrified bonded.
32. An abrasive wheel as claimed in any one of claims 26 to 28, in which the diamond is metal bonded.
33. A plurality of abrasive wheels as claimed in any one of claims 26 to 32 incorporating a different grinding profile.